AD-A163 519 PRELIMINARY PROJECT PLAN REPORT FOR THE EAST COAST AIR COMBAT MANEUVERING..(U) CREST ENGINEERING INC TULSA OK MAY 76 27-771-93 CHES/NAVFAC-FPO-7609 N62477-76-C-0179 1/1

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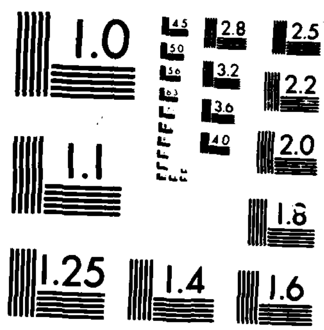

MICROCOPY RESOLUTION TEST CHART
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PRELIMINARY PROJECT PLAN REPORT

FOR THE

EAST COAST AIR COMBAT MANEUVERING RANGE

OFFSHORE KITTY HAWK, NORTH CAROLINA

Unclassified
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Crest Engineering, Inc.

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6c. ADDRESS (City, State, and Zip Code)
Tulsa, OK

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Washington, D.C. 20374-2121

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East Coast Air Combat Maneuvering Range, Offshore construction, Platforms, Towers, Kitty Hawk, NC

19. ABSTRACT (Continue on reverse if necessary & identify by block number)
The proper subject ot this report, is the development of the East Coast Air Combat Maneuvering Range, offshore Kitty Hawk, North Carolina. The portions of the development under consideration herein are the design, fabrication and installation of the four ocean structures which, with electronic gear, (Con't)

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202-433-3881

22c. OFFICE SYMBOL

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compris and define the Range. Two objectives fundamental to the project, are the feasibility of completing the project within the summer of 1977 and the possiblilty of accomplishing the task within the funding avaiable. The preliminary project plan, ~~as reported herein,~~ sets forth ~~a suggested~~ procedure and schedule by which those objectives can be fulfilled.

~~Essentially,~~ this plan considers the various aspects of design engineering, fabrication, transportation and installation for the three primary conceptual configurations considered in the Structural Concept Analysis Report, namely, the three-pile, the four-pile and the skirt-pile structures. The plans for each concept are presented in parallel as required by the ideosyncrasies of each concept.

PRELIMINARY PROJECT PLAN REPORT

FOR THE

EAST COAST AIR COMBAT MANEUVERING RANGE

OFFSHORE KITTY HAWK, NORTH CAROLINA

CONTRACT NO. N62477-76-C-0179

REPORT NO. 27-771-93

Prepared for

NAVAL FACILITIES ENGINEERING COMMAND
DEPARTMENT OF THE NAVY
CHESAPEAK DIVISION

By

CREST ENGINEERING, INC.
TULSA, OKLAHOMA

May 1976

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SECTION 1

INTRODUCTION

1.1 SCOPE OF REPORT

The project subject to this report, is the development of the East Coast Air Combat Maneuvering Range, offshore Kitty Hawk, North Carolina. The portions of the development under consideration herein are the design, fabrication and installation of the four ocean structures which, with electronic gear, comprise and define the Range. Two objectives fundamental to the project, are the feasibility of completing the project within the summer of 1977 and the possibility of accomplishing the task within the funding available. The preliminary project plan, as reported herein, sets forth a suggested procedure and schedule by which those objectives can be fulfilled.

Essentially, this plan considers the various aspects of design engineering, fabrication, transportation and installation for the three primary conceptual configurations considered in the Structural Concept Analysis Report, namely, the three-pile, the four-pile and the skirt-pile structures. The plans for each concept are presented in parallel as required by the ideosyncrasies of each concept.

1.2 STRUCTURAL DESCRIPTIONS

The four ocean structures are to be of the same general configuration though varing in overall height as dictated by the water depths at their respective locations. Essentially, the structures are to be of steel construction, each consisting of a superstructure, a templet and piling.

The four superstructures are to be identical each being comprised of two decks of beam/plate construction supported by tubular columns. The columns are to be laced together with Z-braces occurring immediately below the lower deck, are to extend from the upper deck to the top of the templet and are to be sufficiently long to place the lower deck well above the crest of the design storm wave. Access to the decks is to be provided by a stairway from the top of the templet to the upper deck.

The templets are to be constructed as trussed space-frames having tubular members and battered faces. Their overall height is to be such that each exceeds the mean low water depth at their respective sites by a prescribed amount. Each templet is to be provided with a boatlanding, barge bumpers, and walkways. Corrosion protection is to be provided by a combination of painting, excess material and sacrificial anodes.

Each templet is to be afixed to the ocean floor by means of piling driven through the templet columns into the ocean floor and subsequently attached to the top of the jacket by welding.

The fundamental differences in the three structural concepts is that implied by their nomenclature. Thus, the three-pile concept has a templet resembling a trussed tripod with legs sized to accomodate 36"Ø piling. The four-pile concept has a templet resembling the frustum of a rectangular pyramid and also utilizes 36'Ø piling. The skirt-pile concept duplicates the configuration of the four-pile, but has a smaller comparable base, utilizes 30"Ø piling and has additional trusswork around the base of the templet. The skirt-piling are driven through sleeves provided as

a part of the additional trusswork and subsequently attached thereto by grouting.

All instrumentation and equipment to be mounted on the structures is to be furnished by the Government.

1.3 TIME AND FUNDING

The time requirements for the overall project, as shown in Figures 1.1, 1.2 and 1.3 are specified in weeks and are referenced to the date of award for the Phase B contract. Time requirements for individual phases are shown in more detail in subsequent sections.

Funding requirements, as shown in Table 1, are presented as lump sum costs for the various phases and represent accumulations of detailed costs set forth in the subsequent relevant sections.

1.4 CONTINGENCIES AND POTENTIAL PROBLEMS

The project plans, as formulated and set forth herein, indicate that it is possible to complete the project within the time and funding allocated. However, these plans are subject to a number of contingencies which are listed as follows:

... Successful negotiation of the design contract.

... Timely completion and acceptance of bid package documentation.

... Sufficient interest by industry to sincerely seek construction contract.

. . . Delivery time for materials does not increase.

. . . Availability of a derrick barge.

. . . The actual number of bad weather days during transportation and installation does not grossly exceed the number allotted.

. . . Piling can be driven to grade without jetting.

As listed, the first, third and fifth contingencies may be considered as critical in that should these events not come to pass, the project would have to be cancelled or indefinitely delayed. Conversely, the remaining contingencies pose potential problems in the sense that should any of these suppositions prove false, individually they would not be fatal to the project. Obviously, the combined effect of the failure of several of these latter could seriously delay project completion and consequently increase costs by a significant amount.

Combining the contingencies as listed with the preliminary project plan yields the critical path diagram shown in Figure 1.4. It should be noted, however, that projects of this sort (relatively small expensive structures and sequential operations) do not lend themselves satisfactorily to the critical path method.

PRELIMINARY PROJECT PLAN - FOUR SKIRT - PILE OCEAN STRUCTURES

EAST COAST AIR COMBAT MANEUVERING RANGE

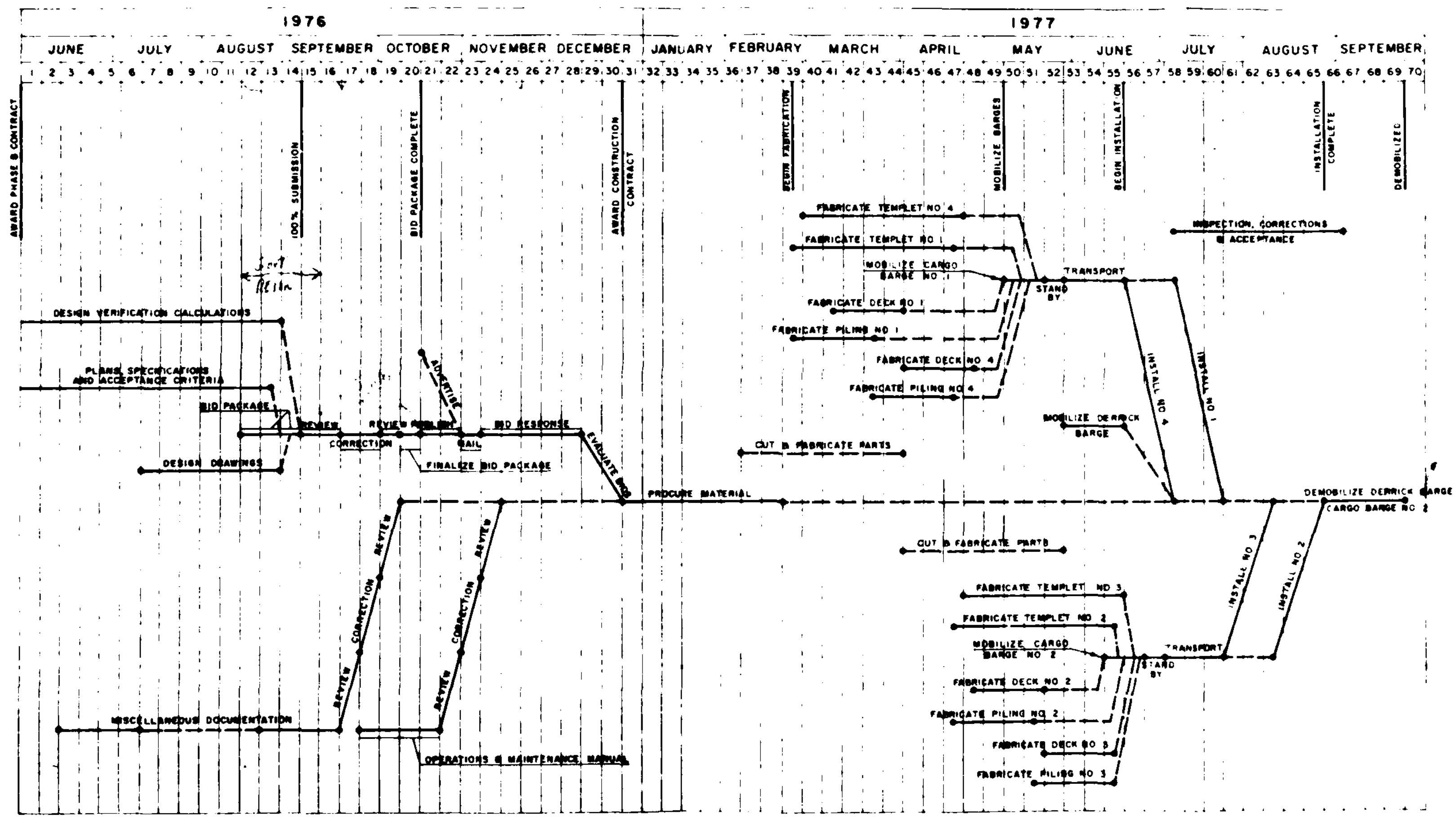


FIGURE 11

PRELIMINARY PROJECT PLAN - FOUR FOUR - PILE OCEAN STRUCTURES

EAST COAST AIR COMBAT MANEUVERING RANGE

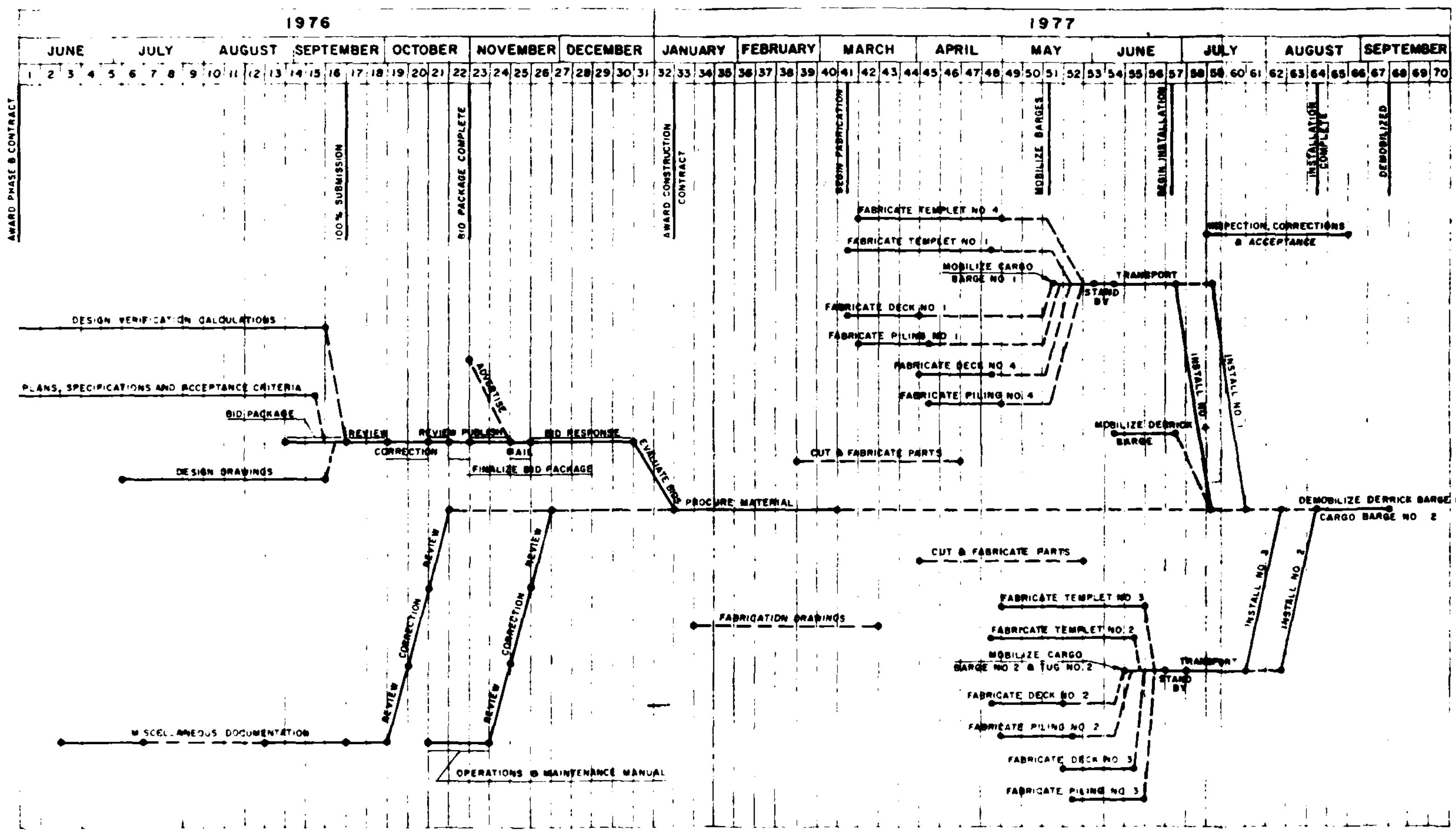


FIGURE 12

PRELIMINARY PROJECT PLAN - FOUR THREE - PILE OCEAN STRUCTURES

EAST COAST AIR COMBAT MANEUVERING RANGE

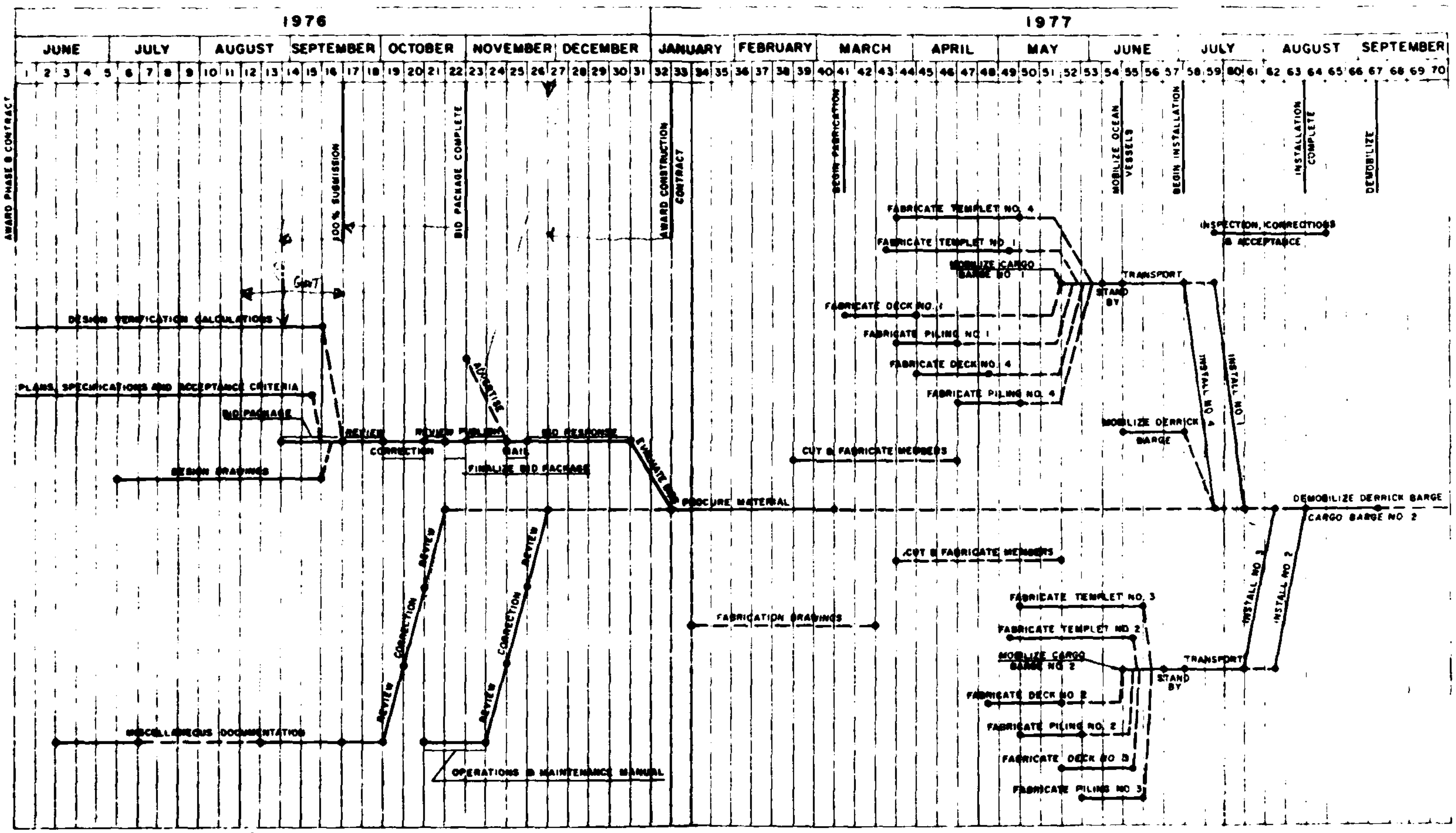


FIGURE 1.3

TABLE 1. FUNDING REQUIREMENTS

Operation	Structural Concept		
	Skirt-Pile	Four-Pile	Three-Pile
Design	$ 252,000	$ 283,000	$ 285,000
Fabrication (Includes Inspection)	4,264,000	3,967,000	3,099,000
Transportation	914,000	797,000	747,000
Installation	3,727,000	2,625,000	2,048,000
Current Estimated Cost	$ 9,157,000	$7,672,000	$6,179,000
10% Escalation	916,000	767,000	618,000
Estimated Cost Installed	$10,073,000	$8,439,000	$6,797,000
Cost Ratio's	1.000	0.838	0.675

CRITICAL PATH DIAGRAM

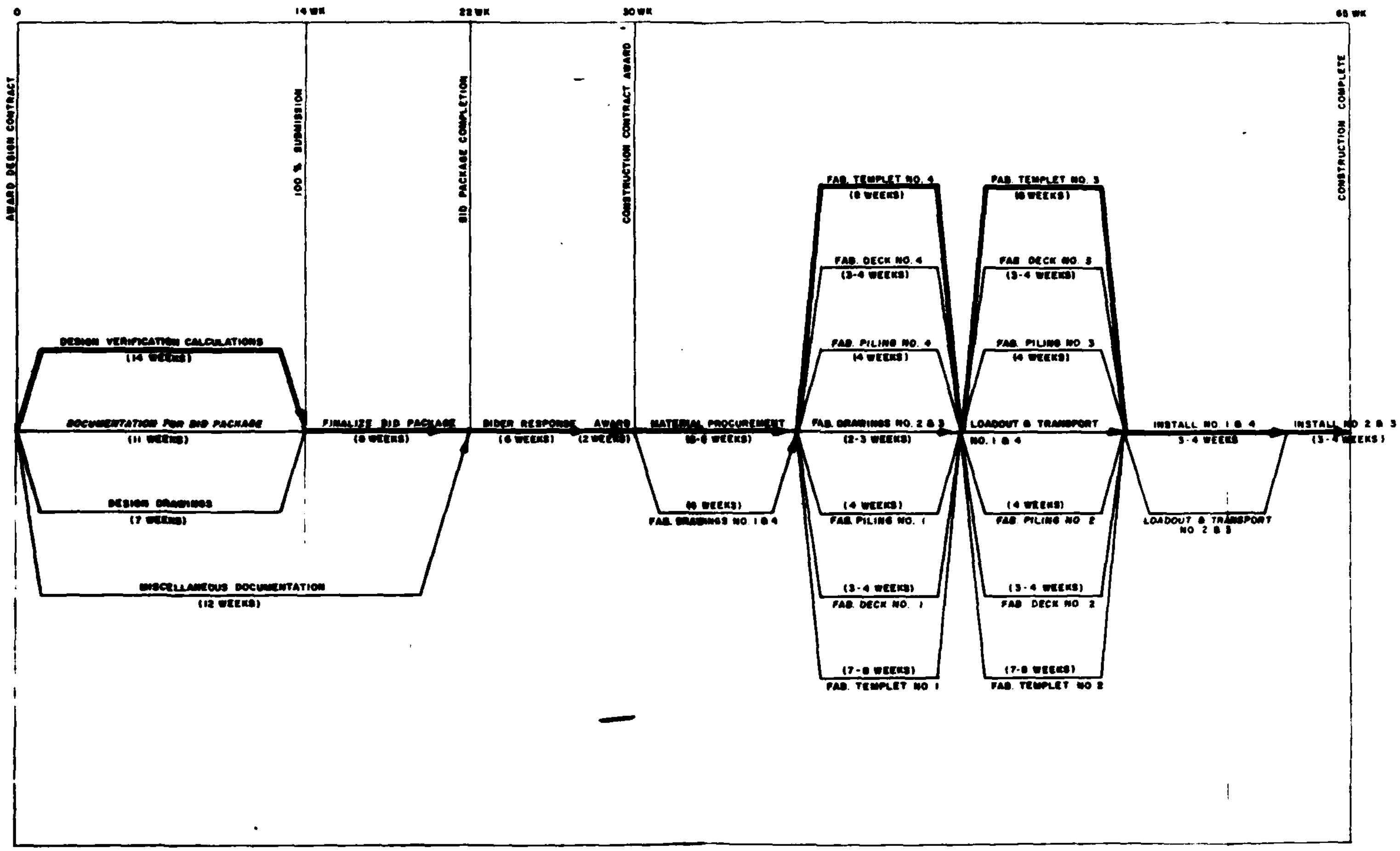


FIGURE 1.4

1.5 PROJECT PERSONNEL

Personnel directly involved in the development of this report are presented hereinafter.

CREST OFFSHORE, INC.

Lowell P. Johnston

President

University	Degree	Year
Texas A&M	Bachelor of Science Civil Engineering	1950
Texas University	Master of Science Civil Engineering	1952
South Texas College of Law	LL.B. (Law)	1963

Societies, Licenses, and Other Activities:

Registered Professional Engineer - Texas, Louisiana, & Okla.
Admitted to the Practice of Law in Louisiana
American Society of Civil Engineers, member
Louisiana Bar Association, member
Published numerous papers on Offshore Engineering

Experience:

1973 to Present — Crest Offshore, Inc.

President

Responsible for overall management, including setting goals and establishing methods for maintaining a high technical competence in consulting engineering firm specializing in offshore engineering.

1970 to 1973 — Shell U.K. Exploration and Production (London)

Senior-Staff Civil Engineer

Overall responsibility for the design of their structures for use in U.K. sector of the North Sea such as platforms in Auk and Brent Fields. Responsible for overall technical evaluation of concrete gravity platforms. Chairman of Work Group which assisted the U.K. Department of Trade and Industry in writing their "Construction and Survey Regulations".

CREST OFFSHORE, INC.

Lowell P. Johnston

President

Experience Continued:

1968 to 1970		Shell Development Company (Houston)
Senior-Staff Civil Engineer		Organized and taught an in-house course in Offshore Civil Engineering which included such topics as operational requirements and forces, wave theory and forces, ice forces, lateral and axial pile design, design procedures, specifications, cost control, fabrication, etc.
1966 to 1968		Shell Oil Company (New Orleans)
Senior-Staff Civil Engineer		Responsible for studies to advance Shell's technology and capability for designing and installing platforms in deeper waters.
1965 to 1966		Shell International Petroleum Mij. (The Hague)
Senior-Staff Civil Engineer		Responsible for the planning and design of one platform in the North Sea and one platform offshore Borneo. Involved in other detail design work relative to large tubular joints, etc.
1963 to 1965		Shell Oil Company (Los Angeles)
Staff Civil Engineer		Project Engineer on the first platform installed in Cook Inlet, Alaska. Assignment included responsibility for establishing criteria, contractual arrangements, etc.
1952 to 1963		Shell Oil Company (Various)
Senior Civil Engineer		Various assignments with duties similar and responsibility increasing with time. Duties included: (1) design and installation of offshore platforms and oil-gas handling/separation facilities, (2) research regarding offshore platforms and (3) mobile rig analyses, etc.

CREST OFFSHORE, INC.

John Ward McCann, Jr.

Senior Staff Engineer

University	Degree	Year
University of Notre Dame	Bachelor of Science Civil Engineering	1958
University of Oklahoma	Master of Science Civil Engineering	1959
Oklahoma State University	Doctor of Philosophy Civil Engineering	1973

Societies, Licenses, and Other Activities:

American Society of Civil Engineers
National Society of Professional Engineers
Registered Professional Engineer - Oklahoma, Louisiana and North Carolina
American Petroleum Institute
Chi Epsilon (Honorary Society)

Experience:

1974 to Present — Crest Offshore, Inc.

Senior Staff Civil Engineer

Responsibilities encompass civil-structural engineering in:
... the design and analysis of structures (both marine and land based),
... the writing of proposals and project specifications,
... the technical support of other staff engineers,
... the development of analytical procedures for the solution of structural problems, and
... any research related to and required for the fulfillment of these areas of responsibility.

1972 to 1974 — Rockwell International

Senior Engineer

Structural Analyst in charge of analysis of aircraft structures using the finite element computer program ASKA.

CREST OFFSHORE, INC.

John Ward McCann, Jr.

Experience Continued:

1969 to 1972		John Zink Company
Structural Engineer		Engineer in charge of design and analysis of steel stacks, (free standing and guyed) pressure vessels and self-supported derricks. Responsibilities also included: ... establishment of a company code governing the design of steel stacks subject to elevated temperatures. ... development of simplified procedures for guy wire analysis and for determination of natural frequency of stacks. ... implementation of cost reduction changes in designs of standard products. ... programming of process calculations, and ... establishment of welding procedures.
1966 to 1969		North American Rockwell
Senior Engineer		Stress Analyst involved in design and analysis of aerospace vehicles, aircraft structures and controls, and ground handling equipment.
1963 to 1966		Chrysler Corporation Space Division
Senior Engineer		Supervised group concerned with analysis of structures subjected to dynamic loads.
1959 to 1963		The California Company (Chevron)
Structural Engineer		Developed theory and wrote program for analysis of laterally loaded piling. Designed and analyzed structures to be used as offshore drilling platforms. Project management responsibilities relative to the design, construction and use of a unique set of pile driving leads for offshore work. Studied vibratory behavior of drilling platforms.
1961 to 1963		George Schrenk (New Orleans)
Structural Engineer		Structural analyst involved in the analysis of buildings and warehouses.

CREST OFFSHORE, INC.

James M. Atkinson

Design Engineer

University	Degree	Year
University of Notre Dame	2 yrs. Aeronautical Engineering	1963
Oklahoma State University	Bachelor of Architectural Engineering	1967

Licenses: Registered Professional Engineer - Oklahoma

Experience:

1975 to Present — Crest Offshore, Inc.

Design Engineer — Designed office buildings and luxury camp for TOTAL Indonesie in Borneo, Indonesia.

1974 to 1975 — Atkinson Engineering Co.

Owner — Independent design work with other consulting engineers on Yale Avenue Methodist Church, new Central High School and new Sear's Building.

1972 to 1974 — Bloom Van Fossen, Brase Architects & Engineering

Associate Engineer — Responsible for the structural design of Copper Oaks Office Park, Sand Springs Shopping Center, East Vue Shopping Center, United Bank, Falls Office Tower and Shopping Center Denver; The Park, The Port and Falls Phase IV.

CREST OFFSHORE, INC.

James M. Atkinson

Design Engineer

Experience Continued:

1970 to 1972		Sullivan Engineering Co., Tulsa Oklahoma
Senior Engineer		Responsible for design of Heilder Tower, Hornet Stadium, Sheraton Inn, Oral Robert's University Dormitories, O.R.U. Geodestic Dome, Hathaway Mfg. Co. Plant, U.S. Jaycees Expansion, Union High School, Ponca City Savings & Loan, 32 story bank building in Tampa, Florida; Clinton Jr. High School, Thoreau Jr. High School and Grissom Elementary School.
1969 to 1970		Craig & Keithline Consulting Engineers, Tulsa, Oklahoma
Junior Engineer		Assisting in the design of bridges, numerous electrical relay stations and river crossing towers. Later became Senior Engineer in charge of designing sewage treatment and water treatment plant structures, schools and commercial buildings.
1967 to 1969		Engineering Pacific, Inc., Portland, Oregon
Junior Engineer		Responsible for the structural design of concrete tilt-up warehouses, rigid frame steel buildings feed and seed mills, residences, office and commercial buildings.

February 26, 1976

SECTION 2

DESIGN PHASE

2.1 DESCRIPTION OF WORK

The work for the Design Phase consists of the development of the design and the preparation of plans, specifications and other designated documents for the four ocean structures for the East Coast Air Combat Maneuvering Range, offshore Kitty Hawk, North Carolina. However, the documentation encompassing design calculations and drawings is to be developed for only three platforms, since two of the four platforms are to be physically identical. Furthermore, the task definition that follows is based on the premise that certain tasks will have been completed prior to the inception of contract. Thus, it is assumed that:

. . . A preliminary design, wind loads and gravity loads, including the effect of buoyancy, have been established for one of the platforms.

. . . The profiles of horizontal velocities and accelerations for the storm wave in the 105 ft water depth have been developed.

. . . With regard to the skirt-pile concept, a set of existing drawings (developed previously for a four-pile structure) is deemed to be of a quality and size acceptable to the Government and also can be revised to depict satisfactorily the skirt-pile concept.

The tasks comprising the work for the Design Phase, as presented

herein, are mostly in accord with the Government's Scope of Work, but in some instances reflect the bias of practice normal to offshore engineering for the Gulf of Mexico. Thus, the tasks comprising the work are defined as follows.

2.1.1. Structural and Foundation Design.

a. Environmental Loads.

(1) Using the storm recurrence interval, the wave theory and the wave/current coupling method designated by the Government, Crest will develop pressure profiles, both horizontal and vertical, for the 81 ft and 93 ft water depths.

(2) Wind forces and wave profiles will be coded and checked for each of the three water depths.

b. Mathematical Models. The mathematical models for three water depths will be developed, and coded.

c. Seaload. The computer will be utilized to ascertain the storm forces on, and the relative position of the wave crest to, the structures when the storm forces are maximum. This operation will be performed for two orientations (0° and 45°) of the structures.

d. Foundation Simulation. Foundation forces reacting the environmental and gravity loadings will be distributed to the individual piling by a rational means. Using an iterative process, McClelland soil data and an assumed magnitude of scour, the piling will be sized and analyzed. Response characteristics of the piling will be simulated by the substitution of an equivalent support system comprised of fictitious springs.

e. Structural Analysis. The structures are to be subjected to gravitational and storm forces and subsequently analyzed to determine joint displacements, member stresses and support reactions. Members are to be resized as required.

f. Structural and Foundation Designs. Approximately three iterations through the "Foundation Simulation" and "Structural Analysis" steps should culminate in the final member and piling sizes.

g. Operational Analysis. Wave profiles are to be developed for a 40 ft wave (T = 13.6") using Stoke's 5th Wave Theory, A. H. Glenn's current velocities and profile, and the constant-volumetric flow wave/current coupling method. Subsequently each structure will be analyzed to established structural

compliance to the operational stability requirements.

h. Joint Analysis. All tubular joints are to be investigated and adjoining members resized as indicated to satisfy punching shear requirements.

i. Natural Frequency Calculations. The mathematical model will be coded to a second format and the natural frequency calculated utilizing a lumped-mass system and the Rayleigh-Ritz Method.

j. Earthquake Analysis. The earthquake analysis will be an equivalent analysis performed utilizing either the method set forth in the API Recommended Practice 2A or that specified as the SEACO Code per NAVFAC P-355.

2.1.2. Life Cycle Fatigue Analysis.

a. General. Fatigue will be given consideration by limiting design-load joint stresses to a maximum value of 20 ksi. (This limitation is applicable to stress prior to amplification by a stress concentration factor.)

b. Finite Element Analysis. A finite element analysis of tubular joints will not be conducted.

c. Joint Fatigue Analysis. Two joints, highly stressed

statically by storm loads, will be chosen for a fatigue analysis. All other joints will be considered acceptable by comparison. The analysis shall be conducted as follows:

(1) Using A. H. Glenn's 20-year spectra of wave heights and periods versus frequencies and Stoke's Fifth Order Wave Theory, the range of maximum and minimum storm force magnitudes on the structure will be calculated and plotted versus wave height. (Vertical wave pressures will not be considered.)

(2) Three wave heights other than the design (61.3 ft) and the operational (40 ft) waves, will be selected and the structure analyzed for both maximum and minimum storm forces. Data from all analyses will be plotted for both of the selected joints thereby establishing a curve depicting joint stress versus storm force. Joint stresses will be amplified using recognized stress concentration factors.

(3) A Modified Goodman Diagram will be constructed using welded joint data developed for the AWS.

(4) Miner's Theory will be used to calculate the fatigue life in cycles for both joints.

2.1.3. Environmental Impact on Installation.

The limiting sea state under which installation can proceed will be specified.

2.1.4. Plans, Specifications and Acceptance Criteria.

a. Drawings.

(1) Skirt-Pile Structure. A set of existing detailed drawings for a four-pile concept, developed under a previous contract, will be adapted to the skirt-pile configuration. Of the eighty-three (83) existing drawings, fifty-five (55) are acceptable "as is" needing only title block changes, nine (9) re-require minor changes, and the remaining twenty-nine (29) need to be redrawn. In addition, approximately thirteen (13) new drawings will be required.

(2) Four-Pile Structure. A new set of detailed drawings, eighty-three (83) in number, will be required.

(3) Three-Pile Structure. A new set of detailed drawings, approximately eighty (80) in number, will be produced.

b. Plans, Specifications and Acceptance Criteria.

These documents, as applicable will be generated for the procurement, fabrication, transportation, installation and life cycle maintenance for the four ocean structures.

2.1.5. Miscellaneous Documents.

Documentation will be produced to define critical factors, potential problem areas, long lead items and to establish a cost estimate.

2.1.6. Interface Specification Drawings.

Approximately eight drawings will be developed based on information supplied by the Government.

2.1.7. Regulatory Requirements and Construction Permit.

Applicable regulatory documents will be reviewed and documentation required for a Construction Permit produced.

2.1.8. Operations and Maintenance Manual.

This manual will be compiled and published. In general, it will contain operational manuals for equipment furnished with the structure, inspection plans and maintenance requirements for the environmental protection system.

2.1.9. Renderings.

One rendering typical of the four structures will be

prepared and submitted with four full size color copies (all glassed and framed) and three 35 mm slides.

2.1.10. Back Check.

In the event errors or omissions are found in the documentation produced above, as determined by the contractural Scope of Work, corrections will be made. All other changes will be considered as a change in contract.

2.1.11. Administrative and Supportive Services.

The administration of the project will be provided by the full time services of a Project Manager and the part time services of a Contracts Administrator and Secretary. Project support will be provided on demand by an engineering aide, reproduction and typists.

2.2 TIME AND MANPOWER REQUIREMENTS

The time schedule suggested for the design phase of the skirt-pile concept, as presented in Figure 2.1, delineates times for the various tasks previously defined and indicates an elapsed period of fourteen weeks from contract approval to 100% Submission. For the two alternate concepts, an additional two weeks will be required at the outset of the project so as to allow time for the adaptation of the selected concept to the respective water depths. Excepting this time differential and the number of drawings required, all other aspects of the design efforts for the individual concepts are identical. Beyond 100% Submission, it is

estimated that an additional five weeks are required for the Governmental review and the subsequent satisfaction of Back Check requirements of the Bid Package. By the end of the twenty-second week, all Phase B documentation efforts will be complete.

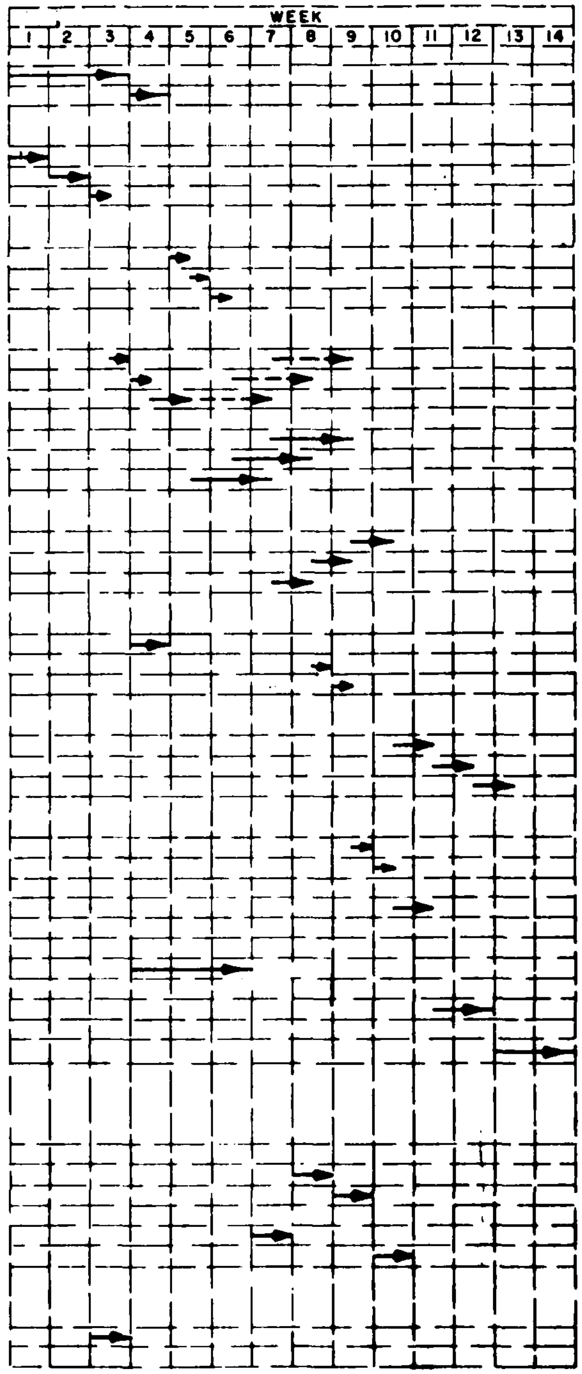
The hours estimated as required to complete the design of the skirt-pile concept are specified by task in Table 2.1. Variations for the other two concepts are shown in Tables 2.2 and 2.3.

2.3 COST ESTIMATES

The estimated cost of the design effort for the skirt-pile concept is reported in Table 2.4. Differences in costing for the other concepts are set forth in Tables 2.5 and 2.6.

FIGURE 2.1

TIME SCHEDULE FOR SKIRT PILE CONCEPT DESIGN



1. STRUCTURAL AND FOUNDATION DESIGN

a. ENVIORNMENTAL LOADS
- (1) PRESSURE PROFILES FOR 81 FT. AND 93 FT MLW
- (2) CODE AND CHECK

b MATHEMATICAL MODELS
- (1) 81 FT. STR.- CODE
- (2) 93 FT STR.- CODE
- (3) 105 FT STR.- MODIFY & CODE

c. SEA LOAD
- (1) 81 FT. STR.- LOADING
- (2) 93 FT. STR.- LOADING
- (3) 105 FT. STR - LOADING

d. FOUNDATION SIMULATION
- (1) 81 FT. STR.- 1 BORING
- (2) 93 FT. STR.- 1 BORING
- (3) 105 FT. STR - 2 BORINGS

e. STRUCTURAL ANALYSIS
- (1) 81 FT. STR.
- (2) 93 FT. STR.
- (3) 105 FT. STR.

f. STRUCTURAL AND FOUNDATION DESIGN
- (1) 81 FT. STR.
- (2) 93 FT. STR
- (3) 105 FT. STR.

g. OPERATION ANALYSIS (105 FT. MLW STR)
- (1) PRESSURE PROFILE
- (2) CODE AND CHECK
- (3) ANALYZE STRUCTURE

h. JOINT ANALYSIS
- (1) 81 FT STR
- (2) 93 FT. STR.
- (3) 105 FT. STR.

i NATURAL FREQUENCY CALCULATION (105' MLW STR)
- (1) CODE MATHEMATICAL MODEL
- (2) ANALYZE

j. EARTHQUAKE ANALYSIS (105 FT. MLW STR.)

k. MISCELLANEOUS DETAILS
(DECKS, STAIRS, HANDRAILS, BOAT LANDING, ETC.)

l. LIFTING ANALYSIS (105' MLW STR)

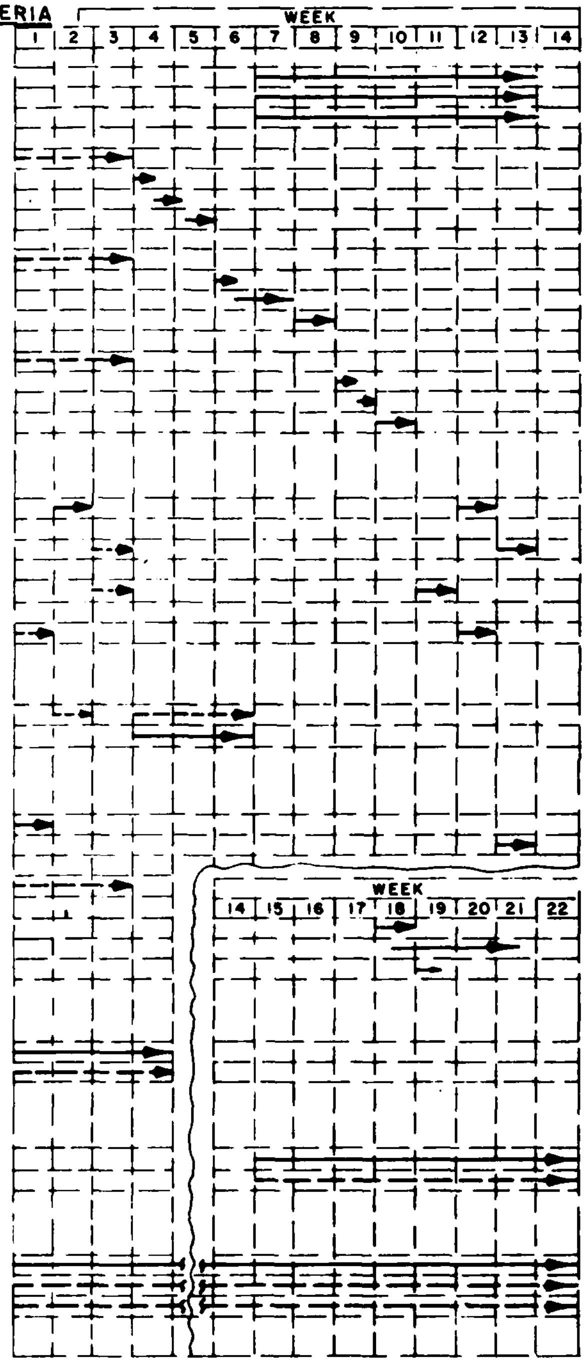
m. EDIT DESIGN ANALYSIS REPORTS

2. LIFE CYCLE FATIGUE ANALYSIS

a. JOINT FATIGUE ANALYSIS (105 FT. STR)
- (1) CODE WAVES (10) AND LOAD STRUCTURE
- (2) ANALYZE STRUCTURE FOR THREE WAVES AND FOR TWO JOINTS. PLOT STRESS VS WAVE FORCE
- (3) DEVELOPE MODIFIED GOODMAN DIAGRAM
- (4) EVALUATE CUMULATIVE FATIGUE WITH MINER'S THEORY.

3. ENVIORNMENTAL IMPACT ON INSTALLATION

FIGURE 2.1



4. PLANS, SPECIFICATIONS & ACCEPTANCE CRITERIA

a. DRAWINGS
  (1) 81 FT. STR
  (2) 93 FT. STR
  (3) 105 FT. STR

b. PLANS
  (1) PROCUREMENT
  (2) FABRICATION
  (3) INSTALLATION

c. SPECIFICATIONS
  (1) PROCUREMENT
  (2) FABRICATION
  (3) INSTALLATION .

d. ACCEPTANCE CRITERIA
  (1) MATERIALS
  (2) FABRICATION
  (3) INSTALLATION

5. MISCELLANEOUS DOCUMENTS

a. CRITICAL FACTORS & POTENTIAL PROBLEMS

b. BILLS OF MATERIALS

c. LONG LEAD ITEMS

d. COST ESTIMATE

6. INTERFACE SPECIFICATION DRAWINGS

a. ENGINEERING EVALUATION
b. DRAWINGS

7. REGULATORY REQUIREMENTS

a. GENERAL REVIEW
b. CONSTRUCTION PERMIT DOCUMENTATION

8. OPERATIONS AND MAINTENANCE MANUAL

a. ENVIORNMENTAL PROTECTION SYSTEMS
b. POTENTIAL DAMAGE, INSPECTION & CORRECTION
c. MISCELLANEOUS ITEMS

9. RENDERINGS

a. VENDER
b. CONSULTATION AND INSPECTION

10. BACK CHECK SUBMISSION

a. ENGINEERING
b. DRAFTING

11. ADMINISTRATIVE

a. PROJECT MANAGER
b. CONTRACTS ADMINISTRATOR
c. SECRETARY

TABLE 2.1

MANPOWER REQUIREMENTS FOR SKIRT-PILE CONCEPT DESIGN

1. STRUCTURAL AND FOUNDATION DESIGN

a.	(2) Code and Check Environmental Loads for Two Water Depths	40 hrs
b.	Code Three Mathematical Models	100 hrs
c.	Analytically Load Three Models and Debug	60 hrs
d.	Foundation Simulation (Four Borings)	120 hrs
e.	Structural Analysis, Debugging and Resizing Members for Three Models	240 hrs
f.	Finalize Designs of Structures and Foundations	120 hrs
g.	Operational Analysis (105 ft MLW Str.)	40 hrs
h.	Joint Analysis (Three Structures)	120 hrs
i.	Natural Frequency Calculation (105 ft MLW Str.)	40 hrs
j.	Earthquake Analysis (105 ft MLW Str.)	40 hrs
k.	Miscellaneous Details	120 hrs
l.	Lifting Analysis (105 ft MLW Str.)	60 hrs
m.	Edit Design Analysis Reports	120 hrs
	Total Engineering Hours for Item 1.	1220 hrs

2. LIFE CYCLE FATIGUE ANALYSIS (105 ft MLW Str.) - - - - - - 160 hrs

3. ENVIRONMENTAL IMPACT ON INSTALLATION - - - - - - - - - - - - 80 hrs

4. PLANS, SPECIFICATIONS AND ACCEPTANCE CRITERIA

a. Drawings

(1)	Title Block Changes Only (49 Dwgs)	81 hrs
(2)	Moderate Changes (12 Dwgs)	240 hrs
(3)	Redraws (22 Dwgs)	704 hrs
(4)	New Drawings (13 Dwgs)	455 hrs

Total Drafter Hours for Item 4.	1480 hrs

b. Plans - 60 hrs

c. Specifications - 120 hrs

d. Acceptance Criteria - 80 hrs

Total Engineering Hours for Item 4.	360 hrs

5. MISCELLANEOUS DOCUMENTS

a. Critical Factors and Potential Problems - - - - - - - 80 hrs

b. Bills of Materials - - - - - - - - - - - - - - - - - - 60 hrs

c. Long Lead Items - 40 hrs

d. Cost Estimate - 40 hrs

Total Engineering Hours for Item 5.	220 hrs

6. INTERFACE SPECIFICATION DRAWINGS

a. Engineering - 40 hrs

b. Drafting (8 Dwgs) - 280 hrs

7. REGULATORY REQUIREMENTS

a. General Review - 40 hrs

b. Construction Permit Documentation - - - - - - - - - - - - 40 hrs

Total Engineering Hours for Item 7.	80 hrs

8. OPERATIONS AND MAINTENANCE MANUAL

a. Environmental Protection Systems - - - - - - - - - - - 40 hrs

b. Potential Damage, Inspection and Correction - - - - - 120 hrs

c. Miscellaneous Items - - - - - - - - - - - - - - - - - - 20 hrs

Total Engineering Hours for Item 8.	180 hrs

9. RENDERINGS

Consultation and Inspection - - - - - - - - - - - - - - 20 hrs

10. BACK CHECK CORRECTIONS

a. Engineering - 120 hrs

b. Drafting - 100 hrs

11. DESIGN HOURS FOR SKIRT-PILE CONCEPT

a. Administrative

Project Manager - 880 hrs

Contracts Administrator - - - - - - - - - - - - - - - - 240 hrs

Secretary - 480 hrs

b. Engineering - 2380 hrs

c. Drafting - 1860 hrs

d. Supportive Services

Engineering Aide - 560 hrs

Reproduction Operator - - - - - - - - - - - - - - - - - 240 hrs

Typists - 300 hrs

TABLE 2.2

MANPOWER REQUIREMENTS FOR FOUR-PILE CONCEPT

1.	STRUCTURAL AND FOUNDATION DESIGN		
	a.	Common Engineering Hours	1280 hrs
	b.	Adaptation of Initial Concept Design	160 hrs
		Total Engineering Hours for Item 1.	1440 hrs
2.	LIFE CYCLE FATIGUE ANALYSIS (105 ft MLW Str.)		160 hrs
3.	ENVIRONMENTAL IMPACT ON INSTALLATION		80 hrs
4.	PLANS, SPECIFICATIONS AND ACCEPTANCE CRITERIA		
	a.	Drafting (83 Dwg)	2656 hrs
	b.	Engineering	360 hrs
5.	MISCELLANEOUS DOCUMENTS		220 hrs
6.	INTERFACE SPECIFICATION DRAWINGS		
	a.	Engineering	40 hrs
	b.	Drafting (8 Dwgs)	280 hrs
7.	REGULATORY REQUIREMENTS		80 hrs
8.	OPERATIONS AND MAINTENANCE MANUAL		180 hrs
9.	RENDERINGS		
		Consultation and Inspection	20 hrs
10.	BACK CHECK CORRECTIONS		
	a.	Engineering	120 hrs
	b.	Drafting	100 hrs

11. DESIGN HOURS FOR FOUR-PILE CONCEPT

a. Administrative

Project Manager - 960 hrs

Contracts Administrator - - - - - - - - - - - - - - - - - 240 hrs

Secretary - 480 hrs

b. Engineering - 2540 hrs

c. Drafting - 3036 hrs

d. Supportive Services

Engineering Aide - 560 hrs

Reproduction Operator - - - - - - - - - - - - - - - - - - 240 hrs

Typists - 300 hrs

TABLE 2.3

MANPOWER REQUIREMENTS FOR THREE-PILE CONCEPT

1.	STRUCTURAL AND FOUNDATION DESIGN	
	a. Common Engineering Hours	1280 hrs
	b. Adaptation of Initial Concept Design	160 hrs
	Total Engineering Hours for Item 1.	1440 hrs
2.	LIFE CYCLE FATIGUE ANALYSIS (105 ft MLW Str.)	160 hrs
3.	ENVIRONMENTAL IMPACT ON INSTALLATION	80 hrs
4.	PLANS, SPECIFICATIONS AND ACCEPTANCE CRITERIA	
	a. Drafting (80 Dwgs)	2800 hrs
	b. Engineering	360 hrs
5.	MISCELLANEOUS DOCUMENTS	220 hrs
6.	INTERFACE SPECIFICATION DRAWINGS	
	a. Engineering	40 hrs
	b. Drafting (8 Dwgs)	280 hrs
7.	REGULATORY REQUIREMENTS	80 hrs
8.	OPERATIONS AND MAINTENANCE MANUAL	180 hrs
9.	RENDERINGS	
	Consultation and Inspection	20 hrs
10.	BACK CHECK CORRECTIONS	
	a. Engineering	120 hrs
	b. Drafting	100 hrs

11. DESIGN HOURS FOR THREE-PILE CONCEPT

a. Administrative

Project Manager - 960 hrs

Contracts Administrator - - - - - - - - - - - - - - - - 240 hrs

Secretary - 480 hrs

b. Engineering - 2540 hrs

c. Drafting - 3180 hrs

d. Supportive Services

Engineering Aide - - - - - - - - - - - - - - - - - - - 560 hrs

Reproduction Operator - - - - - - - - - - - - - - - - - 240 hrs

Typists - 300 hrs

TABLE 2.4

GENERAL EXPENSES FOR DESIGN PHASE

1. Travel

Requirement*	Men	Trips	Man-Trips	Days	Man-Days
I.B.1	1	1	1	1	1
II.B.2	2	1	2	1	2
II.G.	2	1	2	2	4
II.H.	1	2	1	2	2
III.B.II	2	1	2	5	10
III.B.III	1	1	1	3	3
Totals			9		22

*Reference: Government's Scope of Work

Item	Food	Lodging	Transportation	No.	Expense
Daily	$20.00	$35.00	$ 23.00	22	$1716
Air Fare	--	--	196.00	9	1764
Total Travel Expenses			--	-	$3480

2. Vendors

Oceanographer (A. H. Glenn)* - - - - - - - - - - - - - - $3950

Renderings (Arnold & Bouen)** - - - - - - - - - - - - - 1155

Total Vendor's Expense - - - - - - - - - - - - - - - - $5105

*Does not include wind, tides or currents for fatigue analysis.

**See Exhibit A, Item 4.

3. Computer

Computer	Program	No. of Runs	Run Cost	Sub Totals
CDC CYBER 175	Seaload	30	$ 40	$ 1200
CDC CYBER 175	Stran	13	962	12506
IBM 650	Strudl	4	500	2000
IBM 650	L.L.P.	50	8	200
IBM 650	Stoke's 5th	10	5	50
IBM 650	Weights	6	5	30
IBM 650	Plotting	4	10	40
Total	---	--	---	$16026

4. General Expense Summary

Travel - $ 3480

Vendors - 5105

Computer - 16026

Reproduction - 5000

Communications - 1200

Insurance (Tentative for 5 yr.)- - - - - - - - - - - - - 51090

Total General Expenses - - - - - - - - - - - - - - - - - $81901

TABLE 2.5

COST ESTIMATE FOR SKIRT-PILE CONCEPT DESIGN

LABOR COSTS

Item	Hourly Rate	Total Hours	Labor Cost
Project Manager	13.00	880	$ 11,440
Contract Administrator	12.00	240	2,880
Secretary	4.00	480	1,920
Engineers	10.50	2380	24,990
Engineering Aide	7.00	560	3,920
Draftsmen (45 hr. wk.)	6.75	1860	12,555
Reproduction	4.50	240	1,080
Typists	3.50	300	1,050
Direct Labor Totals		6940	$ 59,835
Labor Overhead (0.30%)			17,950
Administrative Expenses (0.90%)			70,007
Profit (0.15%)			22,169
Total Labor Costs			$169,961

PROJECT TOTAL COSTS

General Expenses - - - - - - - - - -	$ 81,901
Labor Costs - - - - - - - - - - - -	169,961
Total - - - - - - - - - - - - - - -	$251,862

TABLE 2.6

COST ESTIMATE FOR FOUR-PILE CONCEPT DESIGN

LABOR COSTS

Item	Hourly Rate	Total Hours	Labor Cost
Project Manager	$13.00	960	$ 12,480
Contract Administrator	12.00	240	2,880
Secretary	4.00	480	1,920
Engineers	10.50	2540	26,670
Engineering Aide	7.00	560	3,920
Draftsmen (45 hr. wk.)	6.75	3060	20,655
Reproduction	4.50	240	1,080
Typists	3.50	300	1,050
Direct Labor Totals		8380	$ 70,655
Labor Overhead (0.30%)			21,197
Administrative Expenses (0.90%)			82,666
Profit (0.15%)			26,178
Total Labor Costs			$200,696

PROJECT TOTAL COSTS

General Expenses - - - - - - - - - - $ 81,901

Labor Costs - - - - - - - - - - - - 200,696

Total - - - - - - - - - - - - - - - - $282,597

TABLE 2.7

COST ESTIMATE FOR THREE-PILE CONCEPT DESIGN

LABOR COSTS

Item	Hourly Rate	Total Hours	Labor Cost
Project Manager	$13.00	960	$ 12,480
Contract Administrator	12.00	240	2,880
Secretary	4.00	480	1,920
Engineers	10.50	2590	26,670
Engineering Aide	7.00	560	3,920
Draftsmen (45 hr. wk.)	6.75	3180	21,465
Reproduction	4.50	240	1,080
Typists	3.50	300	1,050
Direct Labor Totals		8500	$ 71,465
Labor Overhead (0.30%)			21,439
Administrative Expenses (0.90%)			83,614
Profit (0.15%)			26,478
Total Labor Costs			$202,996

PROJECT TOTAL COSTS

General Expenses - - - - - - - - - -$ 81,901

Labor Costs - - - - - - - - - - - - 202,996

Total - - - - - - - - - - - - - - -$284,897

SECTION 3

FABRICATION

3.1 DESCRIPTION OF WORK

The work for the Fabrication Phase of the subject project consists of the construction, loadout and seafastening of the structural components of the four ocean structures for the East Coast Air Combat Maneuvering Range, offshore Kitty Hawk, North Carolina. The tasks comprising the work are defined as follows:

3.1.1. Facilities.

The contractor is to furnish all personnel, materials, supplies, tools equipment including marine and floating, support facilities and all other services, items and facilities necessary to construct, loadout and seafasten the four ocean structures.

3.1.2. Procurement of Materials.

The Bill of Materials, compiled by the A & E Contractor, will be checked for accuracy and completeness. Subsequently materials will be ordered not only for the structures, but also for any supplementary items such as jigs and fixtures.

3.1.3. Fabrication Drawings.

Shop drawings will be prepared for the cutting, fitting and fabrication of the structural subassemblies, component parts and all jigs and fixtures required during the

construction, loadout and seafastening operations.

3.1.4. Fabrication.

a. Superstructures. The component parts will be cut, fitted and assembled by welding. Subsequently, the structures will be sandblasted and painted in accordance with the pertinent specifications.

b. Templets. The component parts will be cut, fitted and assembled by welding. Subsequently, the splash zone area will be sandblasted and painted in accordance with the pertinent specifications. Anodes for the cathodic protection system will be acquired and installed.

c. Piling. The piling will be fabricated in recommended lengths and marked relative to both structure number and sequency of installation. A plan will be developed relative to piling loadout so as to minimize handling at the respective offloading sites.

3.1.5. Loadout and Seafastening.

The structural subassemblies, piling and ship-loose parts are to be loaded onto barges furnished by either the installation contractor or the U.S. Government and fastened satisfactorily thereto so as to sustain the sea state set forth in the specifications.

Plausible loadout arrangements for the three concepts are shown in Figure 3.1. For the arrangements shown, it is assumed that the templets will be on blocks or skids and the piling sections will be underneath.

3.2 TIME REQUIREMENTS

The time required for the Fabrication Phase of the Project is estimated and shown by structural concept in Figures 1.1, 1.2 and 1.3. Please note that for small structures such as these, the weight differential has a negligible effect on fabrication time requirements.

3.3 COST ESTIMATE

The costing of the project is based on a price per ton for type of construction and is tabulated for the three structural concepts in Tables 3.1, 3.2 and 3.3.

3.4 INSPECTION QUALITY ASSURANCE

So as to maintain quality assurance, it is recommended that independent inspectors be hired for the duration of the fabrication effort. One inspector should be on the project at the time material starts arriving. Also, this inspector should attended any preconstruction conferences that take place. A second inspector should start on the project at the time fabrication actually begins. Costs for these fabrication inspection services are estimated in Table 3.4.

Additionally, it is suggested that the fabrication contractor be required to perform non-destructive weld inspections in accordance with that schedule given in Table 3.5.

FIGURE 3.1 FABRICATION SEQUENCE

1. Material Procurement. @ 6 - 8 wks

   a. Check Bills of Material.

   b. Issue Purchase Orders.

   c. Receive and Inspect Materials.

2. Preparations.

   a. Prepare Fabrication Drawings.

   b. Cut and Fabricate Parts.

3. Fabrication of Structures No. 1 and 4. @ 6 - 8 wks

   a. Templets (Simultaneous Construction).

      (1) Layout, Fit and Weld Truss 1.

      (2) Layout, Fit and Weld Truss 2.

      (3) Stand Up Trusses 1 and 2.

      (4) Fit and Weld Members for Trusses A and B.

      (5) Fabricate and Install Accessory Items (Boatlanding, etc.).

      (6) Sandblast and Paint Splash Zone.

      (7) Install Anodes.

   b. Superstructures (Sequential Construction).

      (1) Layout, Fit and Weld Decks (Upside Down).

      (2) Layout, Fit and Weld Mainframe (Upright).

      (3) Right Decks and Install.

      (4) Fabricate and Install Stairs.

      (5) Sandblast and Paint.

      (6) Install Contractor Supplied Equipment (Winches, etc.).

   c. Piling (Sequential Construction).

4. Loadout and Seafastening. @ 1 - 2 wks

   a. Piling.

   b. Superstructures.

   c. Templets

5. Structures No. 2 and 3. @ 6 - 8 wks

   Structures No. 2 and 3, built after No. 1 and 4 are complete, will follow the construction schedule given above.

TABLE 3.1 FABRICATION COST ESTIMATE FOR SKIRT-PILE CONCEPT

Structure	Structural Weights (Tons)		
	Superstructure*	Templet**	Piling
1. 81 Ft MLW	78	220	380
2. 93 Ft MLW	78	238	389
3. 105 Ft MLW	78	246	393
4. 105 Ft MLW	78	246	393
Totals	312	950	1555

* Includes Stairway
** Includes Boatlanding

Type Construction	Weight (Tons)	Unit Price* ($/Ton)	Total Price ($)
Superstructure	312	2,500	780,000
Templet	950	2,000	1,900,000
Piling	1555	1,000	1,555,000
Totals	2817	-----	$4,235,000

* Includes Environmental Protection

TABLE 3.2 FABRICATION COST ESTIMATE FOR FOUR-PILE CONCEPT

Structure	Structural Weights (Tons)		
	Superstructure*	Templet**	Piling
1. 81 Ft MLW	89	172	362
2. 93 Ft MLW	89	196	371
3. 105 Ft MLW	89	208	375
4. 105 Ft MLW	89	208	375
Totals	356	784	1483

* Includes Stairway
** Includes Boatlanding

Type Construction	Weight (Tons)	Unit Price* ($/Ton)	Total Price ($)
Superstructure	356	2,500	890,000
Templet	784	2,000	1,568,000
Piling	1483	1,000	1,483,000
Totals	2623	-----	$3,941,000

* Includes Environmental Protection

TABLE 3.3 FABRICATION COST ESTIMATE FOR THREE-PILE CONCEPT

Structure	Structural Weights (Tons)		
	Superstructure*	Templet**	Piling
1. 81 Ft MLW	77	129	273
2. 93 Ft MLW	77	147	282
3. 105 Ft MLW	77	156	286
4. 105 Ft MLW	77	156	286
Totals	308	588	1127

* Includes Stairway
** Includes Boatlanding

Type Construction	Weight (Tons)	Unit Price* ($/Ton)	Total Price ($)
Superstructure	308	2,500	770,000
Templet	588	2,000	1,176,000
Piling	1127	1,000	1,127,000
Totals	2023	-----	$3,073,000

* Includes Environmental Protection

TABLE 3.4 FABRICATION INSPECTION SERVICES

Concept	Inspector Man-Weeks			Cost* ($)
	#1	#2	Total	
Skirt-Pile	23	17	40	$28,000
Four-Pile	21	15	36	25,920
Three-Pile	21	15	36	25,920

* Based on $720 per 48 hr week including per diem

TABLE 3.5 RECOMMENDED PERCENTAGES FOR WELD INSPECTION

Type Inspection	Weld Type Construction	Percent*
Radiographic	Longitudinal Welds	
	Column Joint Cans for Templet and Deck	100%
	Remaining Column and Piling Cans	15%
	All Other Cans	15%
	Circumferential Welds in Yard	100%
Ultrasonic	Main Tubular	100%

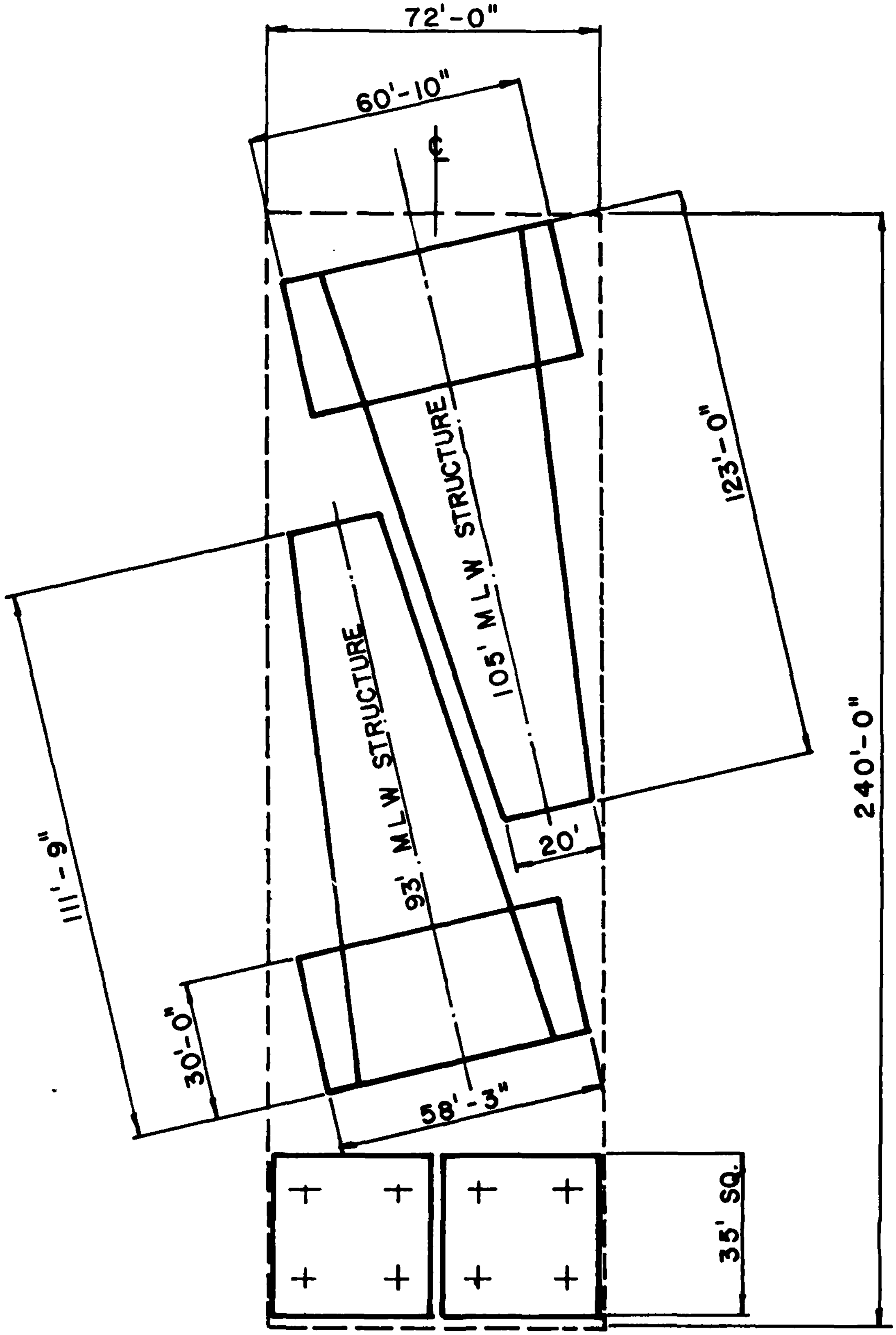


FIG. 3.2A SKIRT PILE STRUCTURES

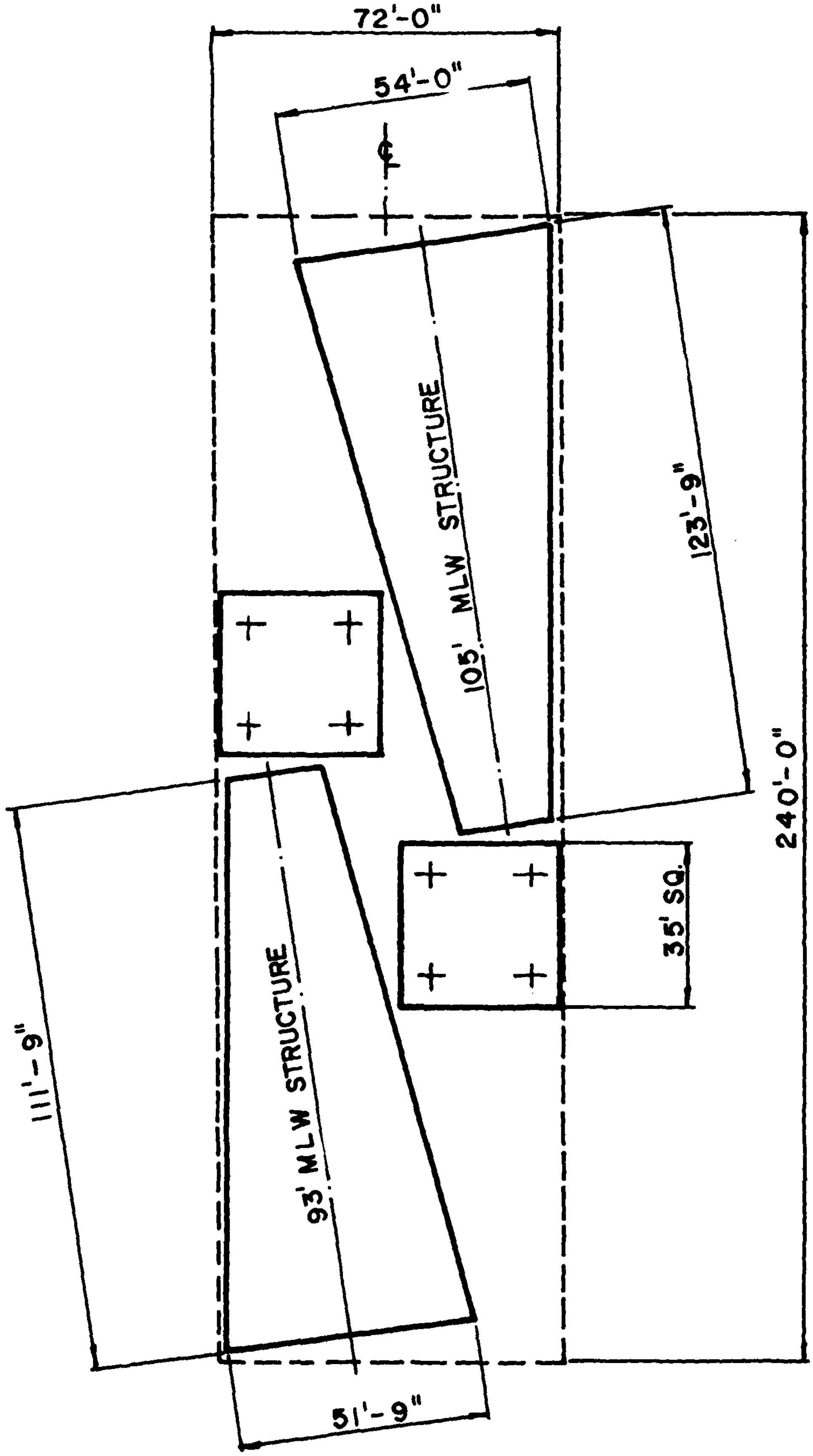


FIG. 3.2B FOUR PILE STRUCTURES

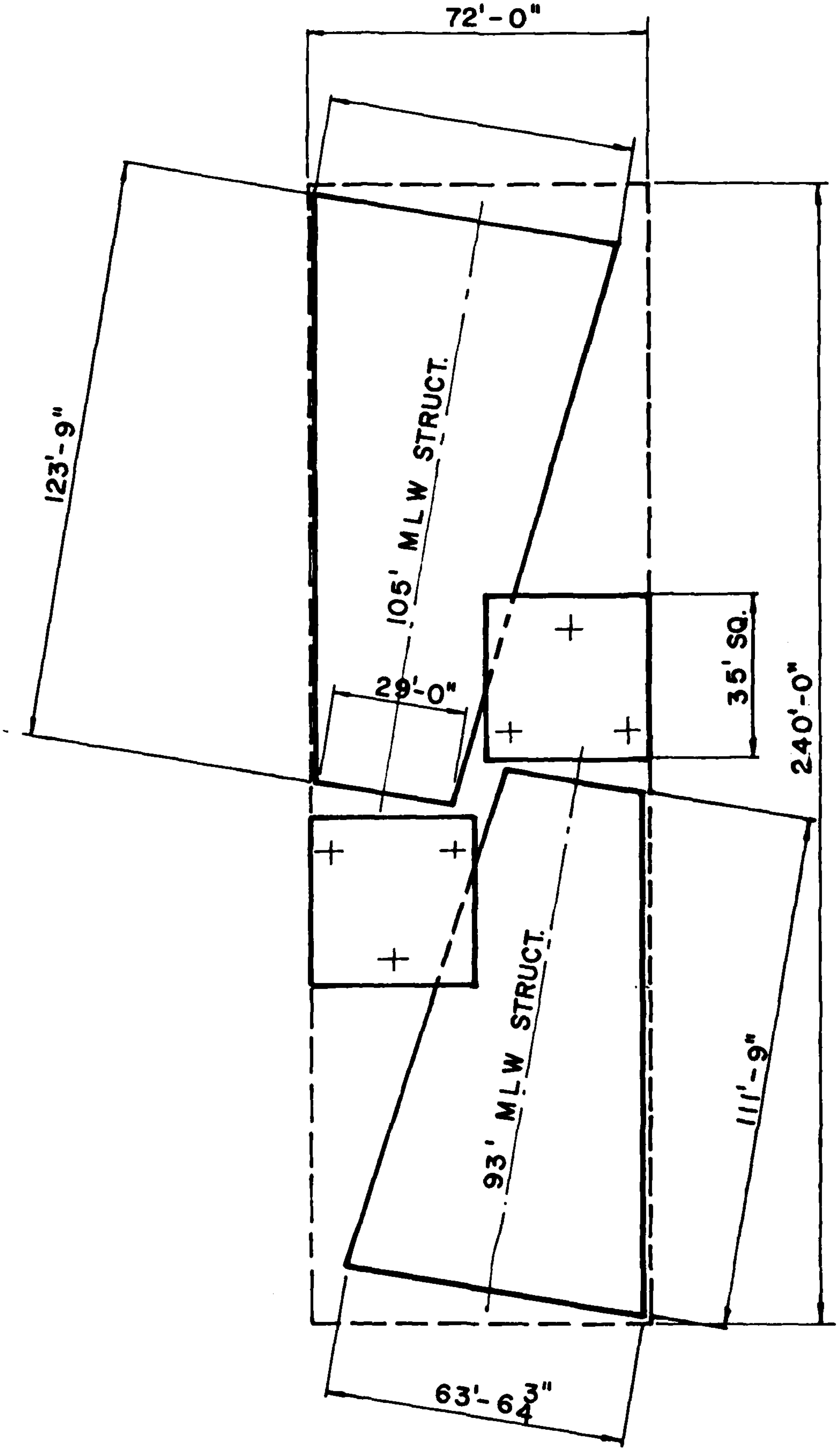


FIG. 3.2C THREE PILE STRUCTURES

SECTION 4

TRANSPORTATION

4.1 DESCRIPTION OF WORK

Functionally, the requirements for the transportation phase consist of:

... Providing two cargo barges (240 ft & 72 ft) with attendant tugs and crews.

... Transporting barges to fabrication yard and standing by during loadout.

... Transporting barges with cargo's from the fabrication yards to the installation sites (See Figure 4.1).

... Standing by till all structures have been offloaded.

... Returning to barges to base point.

4.2 TIME REQUIREMENTS

The time requirement for the cargo barges and tugs are obtained for each structural concept by referring to Figures 1.1, 1.2 and 1.3. These requirements are based on the assumption that the structures are to be fabricated on the Gulf Coast in the vicinity of New Orleans, Louisiana. Time requirements are tabulated in Table 4.1.

4.3 ESTIMATED COST

Estimates of transportation costs are given in Table 4.4.

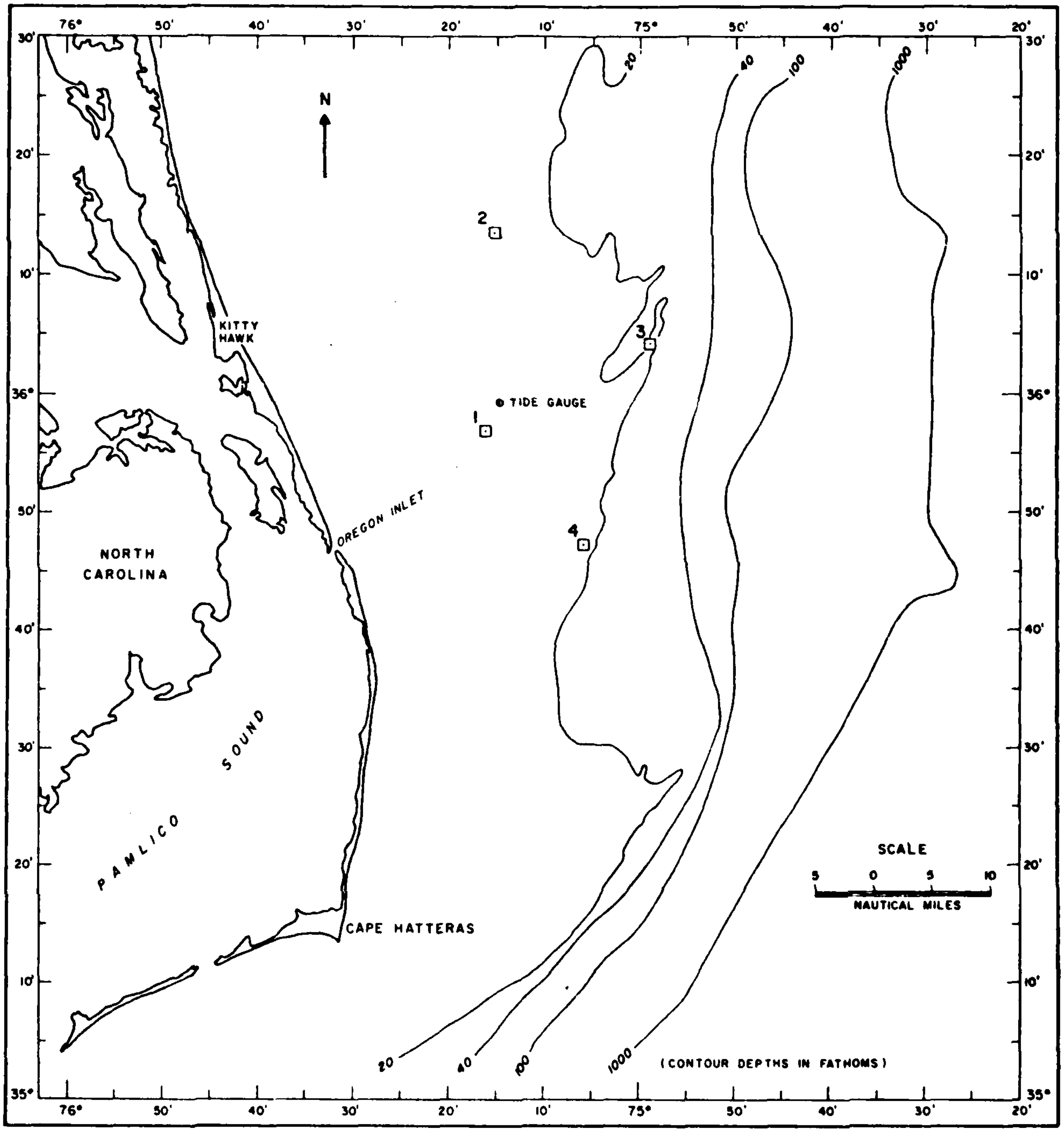


Figure 4.1. Index Map Showing Approximate Location of the Four Proposed Tower Sites

TABLE 4.1 BARGE TIME AND COST REQUIREMENTS

Operation	Time Requirements (Days)					
	Skirt-Pile Concept		Four-Pile Concept		Three-Pile Concept	
	Barge #1	Barge #2	Barge #1	Barge #2	Barge #1	Barge #2
1. Loadout	14	14	14	14	14	14
2. Standby at Yard	7	7	7	7	7	7
3. Transportation*	21	21	21	21	21	21
4. Standby at Site***	35	35	24	24	20	20
5. Demobilization	21	28	21	24	21	21
Totals per Barge	98	105	87	90	83	83
Barge Days/Concept	203		177		166	
Transportation Cost***	$913,500		$796,500		$747,000	

* Based on 1600 mile tow @ 100 miles per day and five (5) bad weather days

** See Section 5

*** Based on $4,500 per day for Barge, Tug and Crew

SECTION 5

INSTALLATION

5.1 DESCRIPTION OF WORK

The installation phase of the project is considered, in general terms, to encompass the following:

. . . The provision of a derrick barge with tug and crews from the time of mobilization through use and demobilization.

. . . The provision of a surveying crew to mark erection sites.

. . . Offloading and erection of the four ocean structures.

. . . The provision of all equipment, material and labor required to effect installation.

. . . The provision of all crew and/or supply boats with crews.

From the standpoint of sequence of operations, it is proposed that the structures be erected in the order 4, 1, 3, 2 (See Figure 4.1). The sequence is formulated on transportation consideration; i.e., one long and one short templet on each barge and, a minimization of distance traveled between erection sites.

Functionally, the erection procedure for each structure will be as follows:

. . . With the traveling block, pickup, stab the first section of each piling. Allow the piling to sink under own weight and then block off to templet. (For the concepts having four main piling, diagonally opposed sets of piling should be stabbed sequentially.)

. . . With main block, pickup hammer and drive first section of each piling. While subsequent piling are being driven, cut off the top two feet of the piling.

. . . With traveling block, pickup and stab second section of one of the piling. Weld off and drive. Repeat process till all piling are driven to grade.

. . . Set shims and weld off.

. . . Cut off excess piling at working point.

. . . (For skirt-pile structure, follow the same general procedure used for the main piling. However, a piling follower must be used to drive the piling to grade (top will be underwater). After driving is complete, set packers in skirt-pile sleeves and grout).

. . . Pickup and set superstructure. Weld off columns.

. . . Pickup barge anchors and move to next site.

. . . Clean and paint welded areas.

5.2 TIME AND COST ESTIMATES

Time requirements for the various aspects of installation are shown subsequently herein in Tables 5.1, 5.2 and 5.3. Day rates are specified in Table 5.4 and cost estimates are presented in Tables 5.5, 5.6 and 5.7.

5.3 INSPECTION QUALITY ASSURANCE

During actual installation, it is recommended that independant inspectors be hired so as to maintain quality control and conformance to specifications. This will require three inspectors with two being on site at all times while the third rotates. One engineer should be on board at all times.

It is further recommend that all welding of main members, (piling, shims, columns) be subjected to 100% Ultrasonic Inspection.

5.4 POTENTIAL PROBLEMS

Two very real problems are possible relative to the successful implementation of installation. The first concerns possibility of an adverse sea state which could cause the derrick barge to drag an anchor and run into (and possibly over) the templet. Thus, when waves greater than 12 ft in height begin to develop, the derrick barge should move away from the structure to essentially preclude such a collision. In the early stages of installation, it is desirable to have at least one and preferably two piling stabbed prior to backing off the derrick barge. Also, a tag line from the derrick barge should be connected to the structure to act as buoy line should the templet topple.

The second potential problem concerns the drivability of the piling.

It is suggested that the derrick barge be furnished with jetting equipment to be used in the event that the piling becomes plugged and cannot be driven to grade.

TABLE 5.1 SCHEDULES FOR SKIRT-PILE STRUCTURES

TABLE 5.1A INSTALLATION SCHEDULE

Operation	Time
1. Bring Derrick Barge onto Location and Set Anchors	1 Day
2. Bring Up Cargo Barge, Offload and Set Templet	1
3. Pickup, Stab and Drive Piling @ 1 Day Per Piling	8
4. Pickup and Set Superstructure	1
5. Weld Out Superstructure Columns	1
6. Pickup Anchors and Move	1
7. Inclement Weather	4
Total Installation Time per Structure	17 Days

TABLE 5.1B DERRICK BARGE SCHEDULE

Operation	Time
1. Mobilization (Tow Barge @ 1600 Miles)	21 Days
2. *Days on Site (@ 17 Days per Structure)*	68
3. Demobilization	28
Total Derrick Barge Time	117 Days

TABLE 5.1C CREW CHANGES

Crew Function	No. per Shift	No. of Shifts	Shift*** Changes	Total Changes	Man Changes
D. Barge	7	3*	5	15	105
Labor	14	3*	5	15	210
Tug	2	3*	5	15	30
Crew Boat	2	2**	4	8	16
Inspection	1	3	4	12	12
					373

* Two 12-hour shifts on board, third shift ashore
** One shift on board at call, second shift ashore
*** Shift changes once every 14 days

TABLE 5.2 SCHEDULES FOR FOUR-PILE STRUCTURES

TABLE 5.2A INSTALLATION SCHEDULE

Operation	Time
1. Bring Derrick Barge onto Location and Set Anchors	1 Day
2. Bring Up Cargo Barge, Offload and Set Templet	1
3. Pickup, Stab and Drive Piling @ 1 Day per Piling	5
4. Pickup and Set Superstructure	1
5. Weld Out Superstructure Columns	1
6. Pickup Anchors and Move	2
7. Inclement Weather	2
Total Installation Time per Structure	12 Days

TABLE 5.2B DERRICK BARGE SCHEDULE

Operation	Time
1. Mobilization (Tow Barge @ 1600 Miles)	21 Days
2. Days on Site (@ 12 Days per Structure)	48
3. Demobilization	28
Total Derrick Barge Time	97 Days

TABLE 5.2C CREW CHANGES

Crew Function	No. per Shift	No. of Shifts	Shift*** Changes	Total Changes	Man Changes
D. Barge	7	3*	4	12	84
Labor	14	3*	4	12	168
Tug	2	3*	4	12	24
Crew Boat	2	2**	3	6	12
Inspection	1	3	3	9	9
					297

* Two 12-hour shifts board, third shift ashore
** One shift on board at call, second shift ashore
*** Shift changes once every 14 days

TABLE 5.3 SCHEDULES FOR THREE-PILE STRUCTURES

TABLE 5.3A INSTALLATION SCHEDULE

Operation	Time
1. Bring Derrick Barge onto Location and Set Anchors	1 Day
2. Bring Up Cargo Barge, Offload and Set Templet	1
3. Pickup, Stab and Drive Piling @ 1 Day per Piling	3
4. Pickup and Set Superstructure	1
5. Weld Out Superstructure Columns	1
6. Pickup Anchors and Move	1
7. Inclement Weather	2
Total Installation Time per Structure	10 Days

TABLE 5.3B DERRICK BARGE SCHEDULE

Operation	Time
1. Mobilization (Tow Barge @ 1600 Miles)	21 Days
2. Days on Site (@ 10 Days per Structure)	40
3. Demobilization	28
Total Derrick Barge Time	89 Days

TABLE 5.3C CREW CHANGES

Crew Function	No. per Shift	No. of Shifts	Shift*** Changes	Total Changes	Man Changes
D. Barge	7	3*	4	12	84
Labor	14	3*	4	12	168
Tug	2	3*	4	12	24
Crew Boat	2	2**	3	6	12
Inspection	1	3	3	9	9
					297

* Two 12-hour shifts on board, third shift ashore
** One shift on board at call, second shift ashore
*** Shift changes once every 14 days

TABLE 5.4 SCHEDULE OF RATES

Equipment	Day Rate
350 Ton Derrick Barge*	
During Tow	$21,000
On Site	$27,000
250 Ton Derrick Barge*	
During Tow	$17,000
On Site	$23,000
150 Ton Derrick Barge*	
During Tow	$13,000
On Site	$19,000
240 ft x 72 ft Cargo Barge*	$ 4,500
Crew Boat	$ 1,500
Pile Hammers	$ 1,500

* Includes tug and minimum crews

Crew by Shift	No.	Day Rate ($)
Derrick Barge	7	1600
Labor	14	3000
Tug	2	360
Crew	1	100
Inspection	1	144

TABLE 5.5 INSTALLATION COSTS FOR SKIRT-PILE STRUCTURES

Cost Item	Unit Rate	No. of Units	Cost
Surveying	$ 2,350	20 Days	$ 47,000
Derrick Barge (350 Tons)			
During Tow	21,000	49	1,029,000
On Site	27,000	68	1,836,000
Pile Hammer (2)	3,000	76	228,000
Crew Boat	1,500	117	175,500
Inspection	144	75	10,800
Travel Time (Crews)*			
D. Barge	1,600	60	96,000
Labor	3,000	60	180,000
Tug	360	60	21,600
Crew Boat	100	32	3,200
Inspection	144	48 Days	69,000
Man-Changes	250	373	93,300
Total Installation Cost	---	---	$3,727,300

* Based on 4-days per shift change

TABLE 5.6 INSTALLATION COSTS FOR FOUR-PILE STRUCTURE

Cost Item	Unit Rate	No. of Units	Cost
Surveying Crew	$ 2,350	20 Days	$ 47,000
Derrick Barge (250 Tons)			
During Tow	17,000	49	833,000
On Site	23,000	48	1,104,000
Pile Hammer (2)	3,000	56	168,000
Crew Boat	1,500	97	145,500
Inspection	144	55	7,900
Travel Time (Crews)*			
D. Barge	1,600	48	76,800
Labor	3,000	48	144,000
Tug	360	48	17,300
Crew Boat	100	24	2,400
Inspection	144	36 Days	5,200
Man-Changes	250	297	74,300
Total Installation Cost	---	---	$2,625,400

* Based on 4-days per shift change

TABLE 5.7 INSTALLATION COSTS FOR THREE-PILE STRUCTURE

Cost Item	Unit Rate	No. of Units	Cost
Surveying Crew	$ 2,350	20 Days	$ 47,000
Derrick Barge (150 Tons)			
During Tow	13,000	49	637,000
On Site	19,000	40	760,000
Pile Hammer (2)	3,000	48	144,000
Crew Boat	1,500	89	133,500
Inspection	144	47	6,800
Travel Time (Crews)*			
D. Barge	1,600	48	76,800
Labor	3,000	48	144,000
Tug	360	48	17,300
Crew Boat	100	24	2,400
Inspection	144	36 Days	5,200
Man-Changes	250	297	74,300
Total Installation Cost	---	---	$2,048,300

* Based on 4-days per shift change

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